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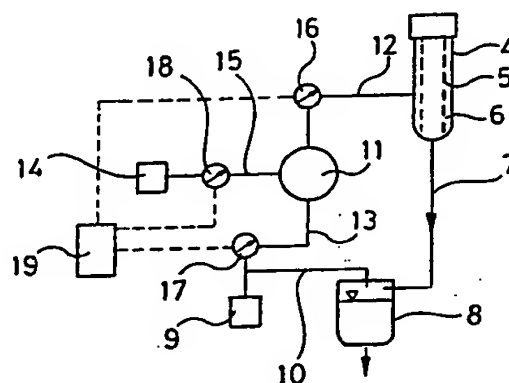
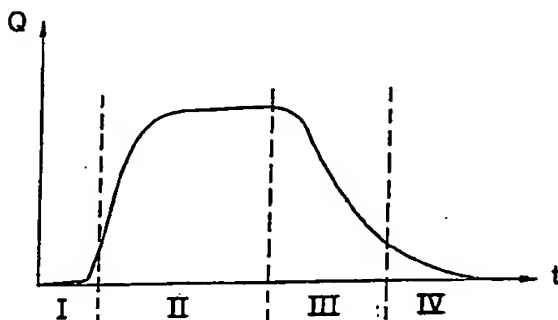
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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(21) International Application Number: PCT/SE92/00021 (22) International Filing Date: 15 January 1992 (15.01.92) (30) Priority data: 9100242-8                      25 January 1991 (25.01.91)      SE (71) Applicant (for all designated States except US): ALFA-LAVAL AGRICULTURE INTERNATIONAL AB [SE/SE]; Farm Center, P.O. Box 39, S-147 21 Tumba (SE). (72) Inventors; and (75) Inventors/Applicants (for US only) : LIND, Ole [SE/SE]; Solbacksvägen 24, S-147 41 Tumba (SE). ÖRNERSFORS, Benny [SE/SE]; Domarvägen 15B, S-921 00 Lycksele (SE). GRIMM, Hartmut [DE/DE]; Plettenbergstrasse 15, D-7000 Stuttgart 1 (DE). RABOLD, Karl [DE/DE]; Wackershofen 1, D-7170 Schwäbisch Hall (DE).	(74) Agent: CLIVEMO, Ingemar; Alfa-Laval AB, S-147 80 Tumba (SE). (81) Designated States: AT (European patent), BE (European patent), CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), LU (European patent), MC (European patent), NL (European patent), SE, SE (European patent), US. Published With international search report.	

(54) Title: METHOD OF MILKING



## (57) Abstract

In a method of milking an animal by using a milking machine having at least one teat cup (4) with a liner (5) and a pulsation chamber (6), the milking machine is operated to pressurize the pulsation chamber, such that during each pulsation the liner opens and/or closes at a slower rate during the beginning and/or ending periods (I, III, IV) of the milking operation than during the main milk extracting period (II) of the milking operation.

Method of milking

The present invention relates to a method of milking an animal by using a milking machine having at least one teat cup with a teat cup liner therein for receiving a teat of the animal, a pulsation chamber being defined between the teat cup and the teat cup liner. There are means for subjecting the pulsation chamber to a pulsating pressure varying between a first pressure and a sub-atmospheric second pressure, which is lower than said first pressure. Each pulsation of said pulsating pressure includes a pressure decreasing phase, during which the pulsating pressure decreases from said first pressure to said second pressure, and a pressure increasing phase, during which the pulsating pressure increases from said second pressure to said first pressure. Means are provided for subjecting the interior of the teat cup liner to said sub-atmospheric second pressure for extracting milk from the animal's teat. The milking of the animal includes in sequence an initial massage period, during which the milk flow begins, a main flow period, during which the milk flow first increases to a main flow and then amounts to said main flow, a flow decreasing period, during which the milk flow at first for a short while amounts to said main flow and then decreases, and a flow terminating period, during which the milk flow ceases.

When milking mechanically it is desirable that the milking of each animal, such as a cow, takes place rapidly, so that the milking machine is efficiently utilized. However, the more rapid the milking operation is carried out, the more rest milk will remain in the udder at the end of the milking operation. Said rest milk must be extracted by manual manipulation of the

of the interior of the teat cup liner means that the teat is treated more gently by the teat cup liner.

During the main flow period, when the larger quantity of the milk is extracted, the pulsating pressure in the pulsation chamber changes at a normal rate, which means that the total milking still can be carried out relatively rapidly.

The invention is explained more closely in the following with reference to the accompanying drawing, in which figure 1 is a graph, which illustrates the size of the milk flow during a milking operation, fig 2-4 are three graphs illustrating the cyclic course of the pressure in a pulsation chamber according to three alternative milking operations according to the invention, and figures 5-7 schematically show three alternative milking machines for accomplishing the milking method according to the invention.

In the graph according to figure 1 there is shown a typical relation between milk flow  $Q$  and time  $t$  during milking of a cow. During an initial massage period I the teats of the cow are stimulated, so that the milk yield begins. Thereafter a main period II follows, during which the milk flow increases to a main flow, which then is relatively constant during a substantial part of the main period II. After the main period II a milk flow decreasing period III follows, during which the milk flow at first for a short while amounts to the main flow and then steadily decreases. Finally a milk flow terminating period IV occurs, during which the milk flow ceases.

In the graph according to figure 4, there is illustrated by the broken lines 2 and 3 how both the opening phase a and the closing phase c are prolonged, if the pulsating pressure changes at a slower rate than along the line 1.

5 (The pulsating pressure both increases and decreases at slower rate). Thus, the prolongations of the opening phase a and the closing phase c means that the interior of the teat cup liner is opened and closed at a slower rate during the same pulsation cycle.

10

The milking machine shown in figure 5 comprises a teat cup 4 with a teat cup liner 5, a pulsation chamber 6 being defined between the teat cup 4 and the teat cup liner 5. From the interior of the teat cup liner 5 a  
15 milk passage 7 leads to a receptacle 8, the interior of which is subjected to a sub-atmospheric low pressure  $P_2$  by a low pressure source 9 via a low pressure passage 10. A pulsator 11 is connected to the pulsation chamber 6 via a pulsation passage 12, to the low pressure source 9 via a low pressure passage 13, and to a high pressure  
20 source 14, which generates a high pressure  $P_1$ , via a high pressure passage 15. The passages 12, 13 and 15 are provided with controllable valves 16, 17 and 18, respectively. A control unit 19 is connected to the valves 16,  
25 17 and 18 for controlling these.

The milking machine according to figure 5 is operated in the following way. The low pressure source 9 subjects the interior of the teat cup liner 5 to the low pressure  
30  $P_2$  via the passage 10, the interior of the receptacle 8 and the passage 7, while the pulsator alternately subjects the pulsation chamber 6 to the high pressure  $P_1$  from the high pressure source 14 via the passages 15 and 12, and to the low pressure  $P_2$  from the low pressure  
35 source 9 via the passages 13 and 12. When the low

kept normal by only reducing the opening rate of the teat cup liner 5, which shortens the milking time somewhat, but gives a somewhat worse teat treatment. Another alternative is to reduce the opening and closing rates of the teat cup liner 5 only during the flow decreasing period III, which substantially reduces the risk of teat cup crawling. Yet another alternative is to reduce the opening rate of the teat cup liner 5 only during the flow decreasing period III and the flow terminating period IV, while the closing rate of the teat cup liner 5 is reduced during the massage period I, the flow decreasing period III and the flow terminating period IV.

15 The milking machine according to figure 6 differs from the milking machine according to figure 5 in that the control unit 19 only is connected to a valve 20, which is arranged in a connection passage 21 A between the high pressure source 14 and the low pressure passage 13, and to a valve 20 A, which is arranged in a connection passage 21 between the low pressure source 9 and the high pressure passage 15. By means of the control unit 19 and the valve 20, a small leakage from the high pressure source 14 to the low pressure passage 13 via the connection passage 21 A can be provided, so that the pressurization of the pulsation space 6 of the low pressure source 9 takes place at a slower rate, whereby the interior of the teat cup liner 5 is opened at a slower rate. As an alternative, a small leakage from the high pressure passage 15 to the low pressure source 9 may be provided by means of the control unit 19 and the valve 20 A, so that the pressurization of the pulsation space 6 by the high pressure source 14 takes place at a slower rate, whereby the interior of the teat cup liner 5 is closed at a slower rate.

with the high pressure passage 15. When the d-phase begins, the control unit 19 closes the valve 27 and then opens the valve 29, so that the accumulation chamber 25 is pressurized by the low pressure source 9. When the  
5 b-phase begins the valve 29 is closed, after which the above described operation is repeated during the next pulsation cycle.

The high pressure source 14 in the milking machine  
10 according to figures 5-7 is suitably constituted by atmospheric pressure.

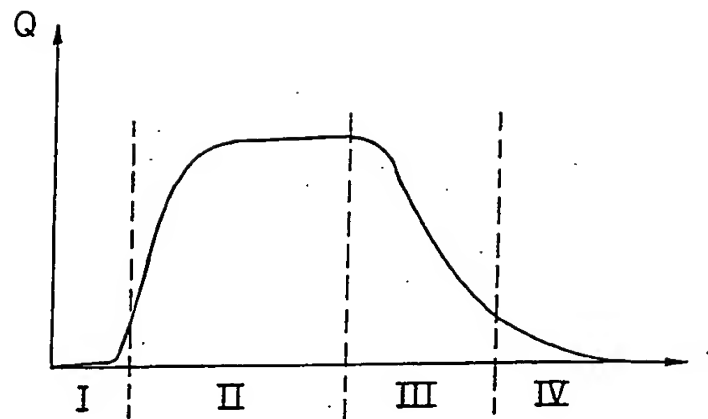
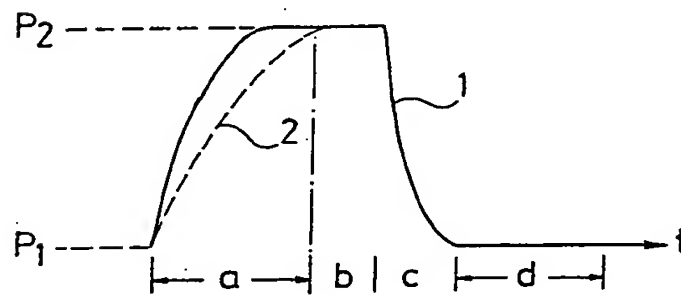
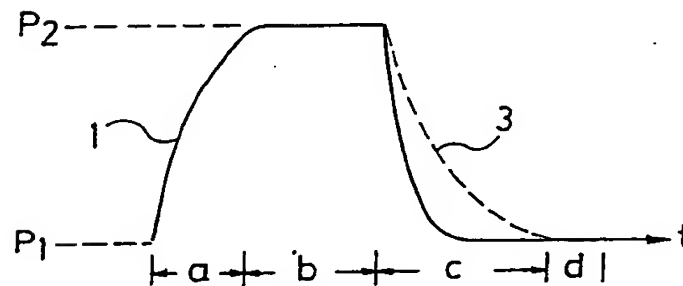
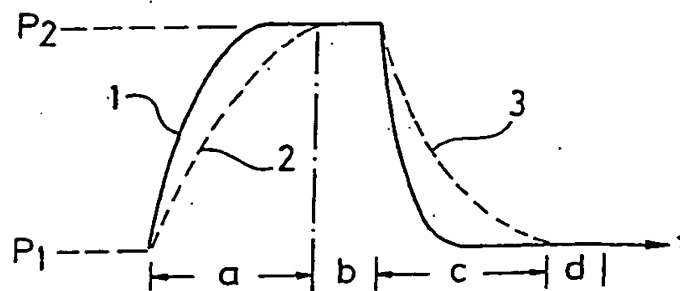
2. A method of milking according to claim 1,  
c h a r a c t e r i z e d b y operating the milking  
machine to decrease the pulsating pressure during said  
pressure decreasing phase (a) of each pulsation at a  
5 slower rate during the massage period (I), the flow  
decreasing period (III) and the flow terminating period  
(IV) than during the main flow period (II).

3. A method of milking according to claim 2,  
10 c h a r a c t e r i z e d b y operating the milking  
machine to increase the pulsating pressure during said  
pressure increasing phase (c) of each pulsation at a  
slower rate during the massage period (I), the flow  
decreasing period (III) and the flow terminating period  
15 (IV) than during the main flow period (II).

4. A method of milking according to claim 1,  
c h a r a c t e r i z e d b y operating the milking  
machine to change the pulsating pressure during each  
20 pulsation at a slower rate during the flow decreasing  
period (III) than during the massage period (I), the  
main flow period (II) and the flow terminating period  
(IV).

25 5. A method of milking according to claim 1,  
c h a r a c t e r i z e d b y operating the milking  
machine to decrease the pulsating pressure during said  
pressure decreasing (a) phase of each pulsation at a  
slower rate during the flow decreasing period (III) and  
30 the flow terminating period (IV) than during the main  
flow period (II) and the massage period (I), and to  
increase the pulsating pressure during said pressure  
increasing (c) phase of each pulsation at a slower rate  
during the massage period (I), the flow decreasing



Fig.1Fig.2Fig.3Fig.4

# INTERNATIONAL SEARCH REPORT

International Application No PCT/SE 92/00021

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (If several classification symbols apply, indicate all) <sup>6</sup> According to International Patent Classification (IPC) or to both National Classification and IPC <b>IPC5: A 01 J 5/04</b>																				
<b>II. FIELDS SEARCHED</b> <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black;">Minimum Documentation Searched<sup>7</sup></div> <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 30%; border-bottom: 1px solid black;">Classification System</th> <th style="border-bottom: 1px solid black;">Classification Symbols</th> </tr> <tr> <td style="height: 40px; vertical-align: bottom; border-right: 1px solid black;">IPC5</td> <td>A 01 J</td> </tr> </table> <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black;">Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched<sup>8</sup></div> <p>SE,DK,FI,NO classes as above</p>			Classification System	Classification Symbols	IPC5	A 01 J														
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IPC5	A 01 J																			
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT<sup>9</sup></b> <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 10%; border-bottom: 1px solid black;">Category *</th> <th style="border-bottom: 1px solid black;">Citation of Document,<sup>11</sup> with indication, where appropriate, of the relevant passages<sup>12</sup></th> <th style="width: 10%; border-bottom: 1px solid black;">Relevant to Claim No.<sup>13</sup></th> </tr> <tr> <td style="text-align: center; vertical-align: top;">Y</td> <td>US, A, 4292926 (TILMAN) 6 October 1981, see the whole document --</td> <td style="text-align: center; vertical-align: top;">1-5</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">Y</td> <td>SE, B, 382547 (ALFA-LAVAL AB) 9 February 1976, see the whole document --</td> <td style="text-align: center; vertical-align: top;">1-5</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">Y</td> <td>SE, B, 408945 (ALFA-LAVAL AB) 16 July 1979, see the whole document --</td> <td style="text-align: center; vertical-align: top;">1-5</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">Y</td> <td>DK, B, 126224 (BIZERBA-WERKE WILHELM KRAUFT KG) 25 June 1973, see the whole document --</td> <td style="text-align: center; vertical-align: top;">1-5</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">A</td> <td>DK, B, 152321 (BIO-MELKTECHNIK SWISS HOEFELMAYR &amp; CO.) 22 February 1988, see the whole document --</td> <td style="text-align: center; vertical-align: top;">1-5</td> </tr> </table>			Category *	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>	Y	US, A, 4292926 (TILMAN) 6 October 1981, see the whole document --	1-5	Y	SE, B, 382547 (ALFA-LAVAL AB) 9 February 1976, see the whole document --	1-5	Y	SE, B, 408945 (ALFA-LAVAL AB) 16 July 1979, see the whole document --	1-5	Y	DK, B, 126224 (BIZERBA-WERKE WILHELM KRAUFT KG) 25 June 1973, see the whole document --	1-5	A	DK, B, 152321 (BIO-MELKTECHNIK SWISS HOEFELMAYR & CO.) 22 February 1988, see the whole document --	1-5
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<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p><b>* Special categories of cited documents:<sup>10</sup></b></p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&amp;" document member of the same patent family</p> </div> </div>																				
<b>IV. CERTIFICATION</b> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border-bottom: 1px solid black;">Date of the Actual Completion of the International Search</td> <td style="width: 50%; border-bottom: 1px solid black;">Date of Mailing of this International Search Report</td> </tr> <tr> <td style="height: 40px; vertical-align: bottom;">28th April 1992</td> <td style="text-align: center; vertical-align: bottom;">1992 -05- 04</td> </tr> <tr> <td style="border-bottom: 1px solid black;">International Searching Authority</td> <td style="border-bottom: 1px solid black;">Signature of Authorized Officer</td> </tr> <tr> <td style="text-align: center; vertical-align: bottom;">SWEDISH PATENT OFFICE</td> <td style="text-align: center; vertical-align: bottom;">Agneta Änggård</td> </tr> </table>			Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	28th April 1992	1992 -05- 04	International Searching Authority	Signature of Authorized Officer	SWEDISH PATENT OFFICE	Agneta Änggård										
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